Executive Summary: Estimating the Short and Long-term Economic & Social Impacts of the 2012 Drought in Colorado[1]

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Abstract: Colorado's ongoing drought is significant in its geographic reach and economic impacts. For farms and ranches, the drought shrinks yields and total crop production, deteriorates pasture condition, reduces cow condition and leads to difficulty in locating critical feed inputs. These production losses generally reduce revenues although declining receipts may be partially offset by higher prices.

Yet, the drought's impacts to the farm or ranch business are not contained within a single season. Much like reservoir levels that are drawn down and may take years to replenish, the impact of a drought can reduce a farm or ranch's equity position making it difficult to service debt or take advantage of future investment opportunities. Equity erosion may take years to rebuild.

In this report, the economic impacts of the ongoing drought, and the longer term impact to farm and ranch resiliency are characterized. The report includes a description of Colorado agriculture, its history of drought, and responses to a recent drought survey. The survey responses are described in order to characterize the potential longer term impacts of drought, and statistical analysis suggests that the operation's relative debt load is the most important factor in predicting a farm's likelihood of exiting the industry. Further emphasis is placed on production losses due to drought and producers' mitigating actions. While it is difficult to forecast the length of the recovery period for Colorado farmers and ranchers, their adaptations and changing production activities in 2012 do indicate the severity and persistence of financial stress.

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Drought continues in Colorado causing significant economic losses, widespread crop failures, damaged rangelands, drastically reduced crop yields and diminished livestock productivity. The financial impacts of drought will be felt by agricultural producers for many years to come and may threaten the long-term economic viability of some agricultural operations.

A recent joint project of the Colorado Department of Agriculture, Colorado Water Conservation Board and Colorado State University seeks to describe the economic consequences of the 2012 drought. The project includes an estimate of the economic impact of the drought and a survey of Colorado ranchers and farmers with related statistical analysis. Key findings are summarized in this Executive Summary and a longer report is available upon request.

Overall Economic Impacts: Table 1 summarizes an estimate of crop revenues in 2012. The values are calculated from data reported by the US Department of Agriculture, National Agriculture Statistics Service (NASS) including estimates of planted acre harvested acres, yields and marketing year prices.

Table 1. 2012 and Average Revenues for Selected Colorado Crops

	2012 Revenues	2000 - 2010 Average Revenue	What Might Have Been Revenues[a]	Difference Between 2012 Revenues and What Might Have Been
Crops				
Barley	$45,663,750	$29,513,530	$46,967,828	-$1,304,078
Corn Grain	$947,026,500	$514,752,255	$1,201,519,061	-$254,492,561
Corn Silage	$166,400,000	$62,668,182	$183,040,000	-$16,640,000
Dry Beans	$32,457,600	$26,968,564	$30,009,411	$2,448,189
Hay (alfalfa & other)	$885,198,000	$473,898,618	$960,408,099	-$75,210,099
Millet	$22,848,000	$20,393,591	$63,542,169	-$40,694,169
Potatoes	$150,678,450	$188,995,952	$145,700,620	$4,977,830
Sorghum	$20,328,000	$14,940,581	$34,285,537	-$13,957,537
Sunflower	$18,313,120	$22,091,421	$28,005,838	-$9,692,718
Wheat	$602,482,930	$301,562,112	$606,979,514	-$4,496,584
Total	$2,891,396,350	$1,655,784,805	$3,300,458,076	-$409,061,726

[a] What Might Have Been Revenues are 2012 prices multiplied by historical average yields multiplied by 2012 planted acres multiplied by the historical ratio of harvested acres to planted acres.

While not an exhaustive list, the crops listed in the first column of Table 1 represent more than ninety percent of crop production in the state and includes both irrigated and non-irrigated cropping. The second column represents an estimate of revenues in which the 2012 marketing year price is multiplied by the 2012 statewide average yield and 2012 harvested acres. Corn grain production represents the greatest revenue generator ($947 million) followed by hay production ($885 million) and wheat production ($602 million). Total crop sales are approximately $2.9 billion.

In spite of the drought, total revenues are significantly higher than the ten year average of 2000 through 2010 that is reported at the bottom of the third column as $1.65 billion. The difference between 2012 revenues and the average amounts are very strong commodity prices in 2012. Persistently high prices were also observed in 2011.

Higher prices mitigate some drought impacts, but farmers experiencing yield losses and/or abandoning planted acres did miss an opportunity to sell some of their crop at higher prices. The fourth column is an estimate of this "foregone" potential – values represent the 2012 marketing year price multiplied by average yields (year 2000 to 2010) multiplied by planted acres for 2012 multiplied by the historical average ratio of harvested to planted acres. More simply, if farmers had an average year in producing crops, but sold at 2012 prices, they would have received $3.3 billion, or about $409 million more than was actually received.

The $409 million of foregone revenues may also be spent on crop inputs or as labor income, both of which might have contributed to other economic activity in the local community. This indirect and induced economic activity is based on an economic concept called a "multiplier." In this context, a multiplier is the total reduction in economic activity divided by the amount of foregone revenues. In sum, the $409 million of foregone revenues (second column of Table 2) resulted in more than $726 million in foregone economic activity (last column of Table 2).

Table 2. Economic Activity Lost as a Result of Foregone Revenues

Crop	Difference Between 2012 Revenues and What Might Have Been	Foregone Indirect and Induced Economic Activity	Sum of Foregone Revenues, Indirect and Induced Economic Activity
Barley (bu/ac)	$1,304,078	$988,322	$2,292,400
Corn Grain (bu/ac)	$254,492,561	$192,872,377	$447,364,938
Corn Silage (tons/ac)	$16,640,000	$12,610,963	$29,250,963
Dry Beans (lbs/ac)	-$2,448,189	-$1,855,410	-$4,303,598
Hay (tons/ac)	$75,210,099	$66,040,493	$141,250,592
Millet (bu/ac)	$40,694,169	$30,840,906	$71,535,074
Potatoes (cwt/ac)	-$4,977,830	-$3,801,866	-$8,779,697
Sorghum (bu/ac)	$13,957,537	$10,578,004	$24,535,541
Sunflower (lbs/ac)	$9,692,718	$5,483,312	$15,176,030
Wheat (bu/ac)	$4,496,584	$3,407,828	$7,904,411
Total	**$409,061,726**	**$317,164,929**	**$726,226,655**

Planted acres are abandoned when the revenues from the crop are smaller than harvest costs. Abandoned acres are one explanation for the $409 million of foregone revenues, but not for every crop. When examining Table 3, large proportions of traditionally non-irrigated crops were not harvested: sunflower, millet and sorghum. The exception is wheat, most of which is grown as a non-irrigated crop in Colorado. Note that sunflower, millet and sorghum are crops sown in the Spring and harvested in the Fall, whereas wheat is planted in the previous September/October and harvested in the July. The full

impact of the drought was not realized statewide until mid to late summer 2012 ***after*** wheat had been harvested. Thus wheat would not be as affected by the 2012 drought when compared other crops.

Table 3. Comparison of Planted vs. Harvested Acres for Selected Crops

	2012		2000 - 2010 Average	
Crops	**Planted Acres**	**Harvested Acres**	**Planted Acres**	**Harvested Acres**
Barley	58,000	55,000	76,818	72,091
Corn Grain	1,420,000	1,010,000	1,184,545	995,455
Corn Silage	N/A[a]	160,000	N/A[a]	108,182
Dry Beans	50,000	45,000	76,636	68,545
Hay	N/A[b]	1,460,000	N/A[b]	1,529,091
Millet	210,000	120,000	261,818	226,818
Potatoes	60,500	59,900	68,173	67,700
Sorghum	245,000	150,000	251,818	155,455
Sunflower	86,000	70,000	151,000	132,727
Wheat	2,363,000	2,182,000	2,438,455	2,122,909

[a]Corn silage acres are reported as "Corn" for planting, but separated into "grain" and "silage" categories at harvest.

[b] Hay is alfalfa and other, but are only reported as harvested acres by USDA-NASS.

Declining yields might also account for foregone revenues, though these could be partially offset by higher prices. Table 4 compares averages yields (irrigated and non-irrigated) for selected Colorado crops. Table 5 illustrates the prices received for these crops relative to their historical averages.

Table 4. Selected Colorado Crop Yields in 2012 and on Average (2000 – 2010)

Crops	**2012 Yield**	**Average Yield (2000 - 2012)**
Barley (bu/ac)	123	119
Corn Grain (bu/ac)	133	143
Corn Silage (tons/ac)	20	22
Dry Beans (lbs/ac)	1,840	1,712
Hay (tons/ac)	2.6	2.7
Millet (bu/ac)	14	26
Potatoes (cwt/ac)	387	373
Sorghum (bu/ac)	20	33
Sunflower (lbs/ac)	788	1,116
Wheat (bu/ac)	34	32

Table 5. Marketing Year Price Received for Selected Crops

	2012 Price Received	Average Price Received (2010-2010)
Crops		
Barley ($/bu)	$6.75	$3.45
Corn Grain ($/bu)	$7.05	$3.04
Corn Silage ($/ton)	$52.00	$26.41
Dry Beans ($/cwt)	$39.20	$24.39
Hay ($/ton)	$235.00	$114.95
Millet ($/bu)	$13.60	$3.81
Potatoes ($/cwt)	$6.50	$7.73
Sorghum ($/bu)	$6.78	$2.74
Sunflower ($/lb)	$0.33	$0.15
Wheat ($/bu)	$8.05	$4.21

Notable reduction in yields is observed for sunflowers, sorghum, millet and corn for grain. Tremendously improved prices can be observed for all crops except potatoes. While the high prices offset revenue losses for farmers, they represent a severe price shock for the buyers of these inputs such as cow-calf producers, feedlots and millers.

The 2012 drought is with few precedents in its intensity and geographic reach. Drought impacts include sharply reduced yields and substantial abandoned acres. Losses were mitigated by historically high prices. These prices are the direct result of short supplies because the drought's reach extended to much f the United States. As a result, the revenues generated by Colorado crop production were well above the historical average of years 2000 through 2010. However, these revenues also represent a missed opportunity – Colorado farmers would have benefitted tremendously if production had been closer to the average. Indeed, foregone revenues total $409 million that would have generated more than $317 million of additional spending in local communities.

The previous analysis is one narrative describing the drought – it represents single year estimated impacts. However, the drought's impacts may multiple year effects eroding farm and ranch owner equity in their business. Equity erosion and sale of capital assets may lead to reduced future profitability and difficulty servicing debt. As a result, a survey of Colorado farm and ranch operations was conducted to gain an understanding of agriculture resiliency.

Survey Scope, Type, and Sampling Strategy: The survey's scope included all Colorado agricultural operations. An internet based questionnaire was designed to fulfill survey objectives, and the internet location of the questionnaire was advertised to agricultural operations via stakeholders that include commodity organizations, farm advocacy groups and CSU Extension. The questionnaire was available from November 2012 to February 2013, and 550 responses were collected.

Demographics: A diverse cross-section of Colorado agriculture completed the survey. Respondents are experienced managers with an average of more than 31 years of experience in farming or ranching. Nearly half report 75% to 100% of their household income comes from farming with a smaller portion (25%) reporting that one-quarter or less of their household income is derived from agricultural operations. Gross revenues from farming are of three general categories: those with less than $50,000 in receipts (43%), between $50,001 and $150,000 of receipts (28%) and those with more than $500,000 in receipts (13%). Almost all (91%) reported serving as the owner and operator of their business.

Respondents' Location by Agriculture Statistics Reporting District

NASS Reporting District	Number of Responses	Percent of Total Responses	Percent of Region Impacted by Drought
Northwest	47	11%	53%
Southwest	75	18%	57%
San Luis Valley	19	5%	84%
Northeast	146	36%	78%
East Central	74	18%	80%
Southeast	**50**	**12%**	**96%**

Drought Impacts of Agricultural Operation Profits: The 2012 drought profits and revenues impacts are mixed: the vast majority of producers are negatively impacted because of yield decreases or input cost increases, but higher prices for some commodities partially offset losses.

Respondents' Profit Changes in 2012 Compared to Typical Year

How much did your farm or ranch PROFITS change in 2012 compared to a TYPICAL year?		
	Number of Responses	Percent of Responses
Lower Profits	195	84%
Greater Profits	38	16%
Average Change Across All Responses	*-43%*	

Forage Production: Livestock, dairy and equine production rely on forage – alfalfa hay, grass hay, range/pasture – in order to provide important feed inputs. When drought occurs, forage production is adversely impacted creating a primary loss for forage producers and a cost shock to livestock producers. Respondents were asked to rate their forage yield and forage quality against a benchmark of a typical year. The benchmark year was considered to be 100% of normal production. Average forage production in 2012 was just 50% of what it would be in a typical year, and forage quality was just 67% of a typical year.

Non Forage Crop Production: Respondents were asked to report yields, acres and insurance participation for a variety of non-forage crops. Summaries of responses to these questions are found below. Dry beans, potato and barley results are not reported to preserve anonymity.

Respondents' Irrigated Crop Yields as a Percent of Typical and Percent Abandoned Acres

Crop	Percent Difference Between Actual and Expected Yield	Percent of Planted Acres Not Harvested Abandoned
Corn Grain	-30%	-19%
Corn Silage	-33%	-16%
Irrigated Wheat	-33%	-6%

Respondents' Dryland Crop Yields as a Percent of Typical and Percent Abandoned Acres

Crop	Percent Difference Between Actual and Expected Yield	Percent of Planted Acres Not Harvested
Dryland Wheat	-28%	-5%
Milo/Sorghum	-65%	-63%
Millet	-75%	-42%
Sunflower	-55%	-44%
Dryland Corn	-86%	-65%

Cow-Calf Production: Livestock producers rely on a variety of sources of forage including owned land, private leases, state leases purchased hay and hay grown for own feeding. As indicated in the table below, the drought caused a shift from grazed land to grown or purchased hay. It is clear that many ranchers fed hay that they grew rather than selling surplus hay or storing for the winter months – grown hay fed to cattle was 186% greater than normal.

Sources of Forage for Cow Calf Production in Typical Years and 2012

AUM Source	AUMs Required by the Operation in a TYPICAL year	Forage Resources Used in 2012	Percent Difference
Owned Pasture/Range	,136	690	-39%
Private Lease	821	762	-7%
Federal Lease	1,313	909	-31%
State Lease	300	198	-34%
Purchased Hay	121	188	55%
Grown Hay	400	1,143	186%

In general, the drought did not adversely impact the weaning and culling percentages of the herd, but it appears respondents did wean place their calves in the feedlot at lighter weights. Also notable is the significant decrease in the overall size of the cow herd – from 203 cows to 105 cows on average.

Cow-Calf Performance Measures During the Drought

Performance Measure	Avg. Performance Measure in a Typical Year	Percent of Normal Performance Measure in 2012

No. of Cows in Herd	203	105
Culling Rate	10%	12%
Weaning Pct.	95%	94%
Avg. Weaning Weight	550	460
Average Cow Cost	$534	$745

Operator Adaptation to Drought: Significant production losses severely impacted some, but not all, agriculture operations in Colorado as a result of drought. Affected operations adapted to/mitigated these economic losses with diverse strategies. As indicated in the table below, respondents sought to reduce family expenses first (59% of respondents) while relatively few took advantage of federal drought assistance (18% of respondents), Respondents were also asked to indicate if they would adopt a practice if the drought continues. A smaller proportion selected reducing family living expenses (41%) as strategy, likely because it is difficult to cut expenses that have already been reduce. An increasing percentage will adopt custom farming, seek off farm employment and obtain federal assistance.

Respondents' Approaches and Participation Rates for Managing Cash Flow

	In response to drought our operation …	***If the drought continues our operation will …***
Custom Farm(ed)	12%	14%
Sought/ Seek Off-Farm Employment	25%	26%
Reduce(d)Family Expense	59%	40%
Sought/ Seek Federal Assistance	18%	25%

Respondents are managing debt to mitigate drought impacts (see table below). The most popular debt management strategy is rolling an operating note into the next year (17%) followed by paying the interest only for a scheduled debt payment (15%) or putting up more collateral (9%). If the drought persists, more operations will seek all debt management strategies.

Respondents' Approaches and Participation Rates for Managing Debt

	In response to drought our operation …	*If the drought continues our operation will …*
Paid / Will Pay Interest Only	15%	16%
Put Up More Collateral	9%	11%
Roll Operating Note Into Next Year	17%	18%

The table below suggests survey respondents are depopulating their cow herd with more aggressive culling in order to cope with drought. Among survey respondents, 41 % indicate they have sold breeding livestock and 29% indicate they will do so if the drought continues. Relatively few have sold land in response to drought (2%) but more will consider doing so if the drought continues (9%).

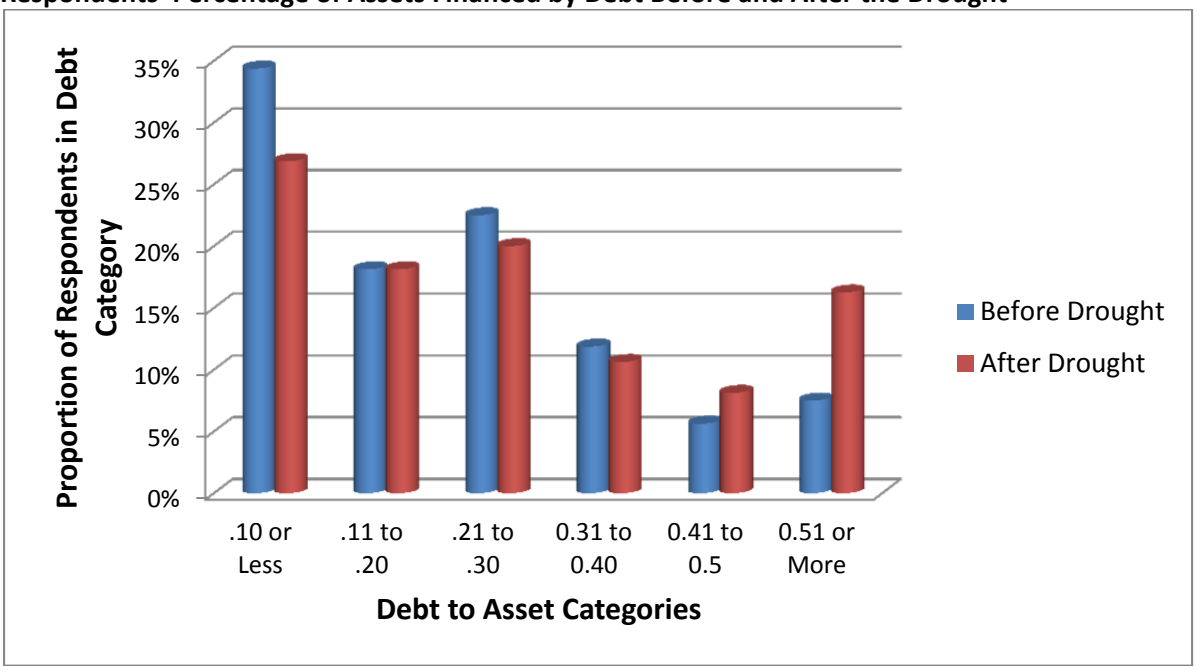
Respondents' Approaches and Participation Rates for Managing Assets

	In response to drought our operation …	*If the drought continues our operation will …*
Sold / Will Sell Breeding Livestock	41%	29%

Sold / Will Sell Equipment	13%	19%
Sold / Will Sell Land	2%	9%

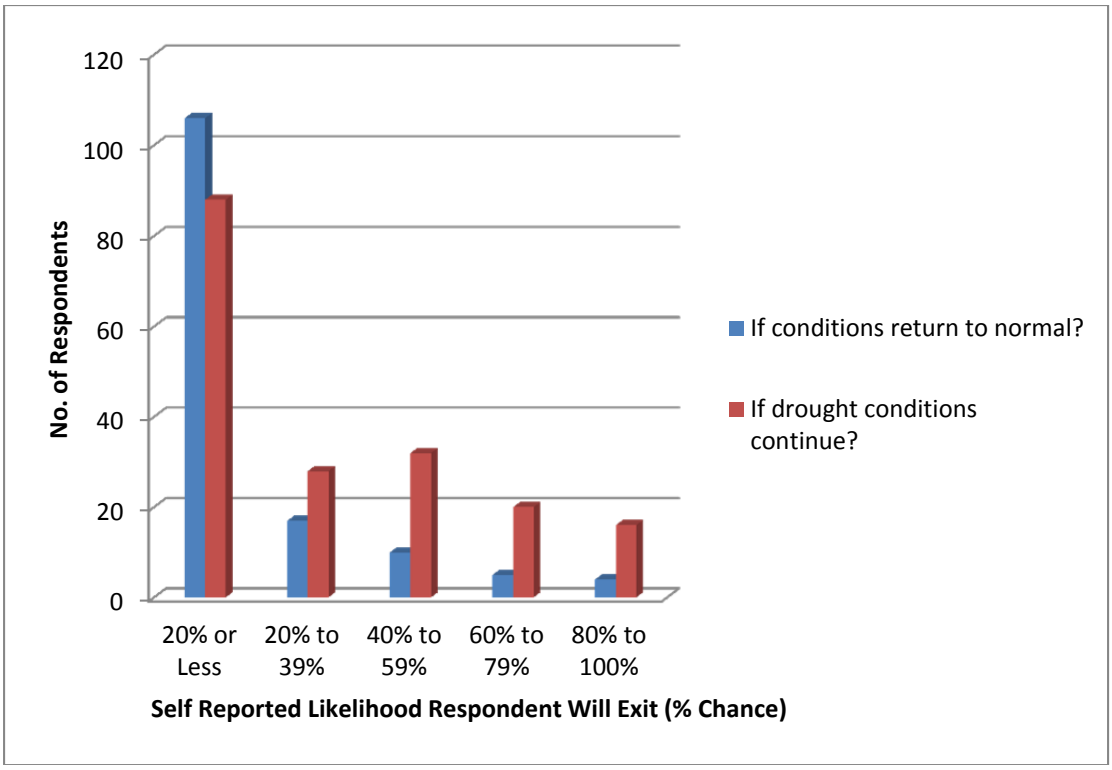
As illustrated in the "Before Drought" and "After Drought" debt to asset percentages in the figure below, the proportion of operations with very little debt has decreased substantially, and those in the highest debt category – 50% or more of assets financed with debt – has increased significantly.

Respondents' Percentage of Assets Financed by Debt Before and After the Drought



Farm and Ranch Resiliency Following the Drought: Resiliency is the ability of the agricultural operation to return to a similar state of production after enduring a stressor such as a drought. The similar "state" includes biological and physical production characteristics, as well as a level if financial assets and performance. One means for measuring resiliency is to ask producers how likely it is that they will exit the industry if the drought continues, and then compare this to the likelihood of exit if conditions return to normal.

Self Reported Likelihood of Exiting the Industry in the Next Five Years



Responses to these questions are illustrated above. The vertical distance of the figure measure the number of respondents and the categories along the horizontal axis is the self reported likelihood of exit for those respondents. Blue bars represent the likelihood if conditions return to normal, and red bars represent the likelihood if the drought continues. As an example in the left-hand corner, 106 respondents indicate that there is a 20% chance or less of exiting the industry if conditions return to normal in 2013. Should the drought continue, only 88 respondents indicate a 20% chance or less of exiting (red bar).

Statistical analysis suggests resiliency is closely related to several factors. First, increasing debt levels increase the likelihood of exit – a result that is not surprising. However, the effect is small, so much so that it may be that a single year's drought will not be sufficient to cause many operations to exit especially since land prices remain strong in affected areas. This year's profits did not have a statistically significant effect on the likelihood of exit furthering the case for multiple years' impacts.

Location matters in the likelihood f exit, but in a confounding way. Respondents in the Southeast agriculture statistics reporting district were less likely to exit compared to the rest of the state in spite of suffering through successive years of drought. Perhaps this is reasonable because growers in southeastern Colorado have adapted their production practices to recurring drought, or because those managers have already begun taking emergency drought measures vis a vis peers in other locations.